# ANNEX Y

## Constants, Units, and Conversions

### Metric Prefixes

Although most activity data for the United States is gathered in customary U.S. units, these units are converted into metric units per international reporting guidelines. The following table provides a guide for determining the magnitude of metric units.

**Table Y-1: Guide to Metric Unit Prefixes**

| Prefix/Symbol | Factor |
|---|---|
| atto (a) | $10^{-18}$ |
| femto (f) | $10^{-15}$ |
| pico (p) | $10^{-12}$ |
| nano (n) | $10^{-9}$ |
| micro (μ ) | $10^{-6}$ |
| milli (m) | $10^{-3}$ |
| centi (c) | $10^{-2}$ |
| deci (d) | $10^{-1}$ |
| deca (da) | 10 |
| hecto (h) | $10^{2}$ |
| kilo (k) | $10^{3}$ |
| mega (M) | $10^{6}$ |
| giga (G) | $10^{9}$ |
| tera (T) | $10^{12}$ |
| peta (P) | $10^{15}$ |
| exa (E) | $10^{18}$ |

### Unit Conversions

1 kilogram = 2.205 pounds
1 pound = 0.454 kilograms
1 short ton = 2,000 pounds = 0.9072 metric tons
1 metric ton = 1,000 kilograms = 1.1023 short tons

1 cubic meter = 35.315 cubic feet
1 cubic foot = 0.02832 cubic meters
1 U.S. gallon = 3.785412 liters
1 barrel (bbl) = 0.159 cubic meters
1 barrel (bbl) = 42 U.S. gallons
1 liter = 0.1 cubic meters

1 foot = 0.3048 meters
1 meter = 3.28 feet
1 mile = 1.609 kilometers
1 kilometer = 0.622 miles

1 acre = 43,560 square feet = 0.4047 hectares = 4,047 square meters
1 square mile = 2.589988 square kilometers

To convert degrees Fahrenheit to degrees Celsius, subtract 32 and multiply by 5/9
To convert degrees Celsius to Kelvin, add 273.15 to the number of Celsius degrees

## Density Conversions[1]

| | | | |
|---|---|---|---|
| Methane | 1 cubic meter | = | 0.67606 kilograms |
| Carbon dioxide | 1 cubic meter | = | 1.85387 kilograms |

| | | | | | |
|---|---|---|---|---|---|
| Natural gas liquids | 1 metric ton | = | 11.6 barrels | = | 1,844.2 liters |
| Unfinished oils | 1 metric ton | = | 7.46 barrels | = | 1,186.04 liters |
| Alcohol | 1 metric ton | = | 7.94 barrels | = | 1,262.36 liters |
| Liquefied petroleum gas | 1 metric ton | = | 11.6 barrels | = | 1,844.2 liters |
| Aviation gasoline | 1 metric ton | = | 8.9 barrels | = | 1,415.0 liters |
| Naphtha jet fuel | 1 metric ton | = | 8.27 barrels | = | 1,314.82 liters |
| Kerosene jet fuel | 1 metric ton | = | 7.93 barrels | = | 1,260.72 liters |
| Motor gasoline | 1 metric ton | = | 8.53 barrels | = | 1,356.16 liters |
| Kerosene | 1 metric ton | = | 7.73 barrels | = | 1,228.97 liters |
| Naphtha | 1 metric ton | = | 8.22 barrels | = | 1,306.87 liters |
| Distillate | 1 metric ton | = | 7.46 barrels | = | 1,186.04 liters |
| Residual oil | 1 metric ton | = | 6.66 barrels | = | 1,058.85 liters |
| Lubricants | 1 metric ton | = | 7.06 barrels | = | 1,122.45 liters |
| Bitumen | 1 metric ton | = | 6.06 barrels | = | 963.46 liters |
| Waxes | 1 metric ton | = | 7.87 barrels | = | 1,251.23 liters |
| Petroleum coke | 1 metric ton | = | 5.51 barrels | = | 876.02 liters |
| Petrochemical feedstocks | 1 metric ton | = | 7.46 barrels | = | 1,186.04 liters |
| Special naphtha | 1 metric ton | = | 8.53 barrels | = | 1,356.16 liters |
| Miscellaneous products | 1 metric ton | = | 8.00 barrels | = | 1,271.90 liters |

## Energy Conversions

### Converting Various Energy Units to Joules

The common energy unit used in international reports of greenhouse gas emissions is the joule. A joule is the energy required to push with a force of one Newton for one meter. A terajoule (TJ) is one trillion ($10^{12}$) joules. A British thermal unit (Btu, the customary U.S. energy unit) is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2 Fahrenheit.

1 TJ =
- $2.388 \times 10^{11}$ calories
- 23.88 metric tons of crude oil equivalent
- 947.8 million Btus
- 277,800 kilowatt-hours

### Converting Various Physical Units to Energy Units

Data on the production and consumption of fuels are first gathered in physical units. These units must be converted to their energy equivalents. The values in the following table of conversion factors can be used as default factors, if local data are not available. See Appendix A of EIA's *Annual Energy Review 1997* (EIA 1998) for more detailed information on the energy content of various fuels.

[1] Reference: EIA (1998a)

## Table Y-2: Conversion Factors to Energy Units (Heat Equivalents)

| Fuel Type (Units) | Factor |
|---|---|
| **Solid Fuels (Million Btu/Short ton)** | |
| Anthracite coal | 22.573 |
| Bituminous coal | 23.89 |
| Sub-bituminous coal | 17.14 |
| Lignite | 12.866 |
| Coke | 24.8 |
| **Natural Gas (Btu/Cubic foot)** | **1,027** |
| **Liquid Fuels (Million Btu/Barrel)** | |
| Crude oil | 5.800 |
| Natural gas liquids and LRGs | 3.777 |
| Other liquids | 5.825 |
| Motor gasoline | 5.253 |
| Aviation gasoline | 5.048 |
| Kerosene | 5.670 |
| Jet fuel, kerosene-type | 5.670 |
| Distillate fuel | 5.825 |
| Residual oil | 6.287 |
| Naphtha for petrochemicals | 5.248 |
| Petroleum coke | 6.024 |
| Other oil for petrochemicals | 5.825 |
| Special naphthas | 5.248 |
| Lubricants | 6.065 |
| Waxes | 5.537 |
| Asphalt | 6.636 |
| Still gas | 6.000 |
| Misc. products | 5.796 |

Note: For petroleum and natural gas, *Annual Energy Review 1997* (EIA 1998b). For coal ranks, *State Energy Data Report 1992* (EIA 1993). All values are given in higher heating values (gross calorific values).

## References


EIA (1998a) *Emissions of Greenhouse Gases in the United States*, DOE/EIA-0573(97), Energy Information Administration, U.S. Department of Energy. Washington, DC. October.

EIA (1998b) A*nnual Energy Review*, DOE/EIA-0384(97), Energy Information Administration, U.S. Department of Energy. Washington, DC. July.

EIA (1993) *State Energy Data Report 1992*, DOE/EIA-0214(93), Energy Information Administration, U.S. Department of Energy. Washington, DC. December.